Light and Lighting

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The Queen Returns
Long Live the Queen!

THE wonderful welcome accorded to Her Majesty the Queen when she returned so recently after the tour that took her round the world must have left her in no doubt whatever of the deep affection of her people, both for herself and for H.R.H. The Duke of Edinburgh and the royal children. Although only 12 months have elapsed since Her Majesty was crowned—and that unforgettable ceremony is still very fresh in the minds of the millions of her subjects who witnessed it directly or indirectly—she has devoted herself with tireless energy to the service of her peoples at home and overseas, and has endeared herself, by her recent visits, to the most distant of her subjects no less than to those in the Mother Country. It is appropriate, we think, on this first anniversary of Her Majesty's Coronation to devote much of our space once again to the Coronation lighting but, now that the actual spectacles are no longer to be seen, we can turn with interest to the technical details of some of the lighting installations.

Notes and News

Visual Problems of Older Workers

In the twenty-sixth Ettles Memorial Lecture, organised by the Association of Optical Practitioners and given in London on May 19, Mr. Stanley M. Wells dealt with the visual problems of older workers in industry. In view of the fact that the average age of workers is rising year by year and that by 1977 it is estimated that one in five workers will be over retiring age (65 for men and 60 for women) the matter is one of some importance. Mr. Wells began by mentioning that the National Advisory Committee on the Employment of Older Men and Women pointed out, in its first report, that it is not a fixed limit of age which decides if a person is old in the industrial sense, but that a person becomes old when he meets with special difficulties on account of his age. One such special difficulty is failing eyesight.

Apart, said Mr. Wells, from short-sighted persons and others who may need spectacles earlier, the majority of persons over 45 require spectacles for close work of any kind. It is only in youth that our eyes are able to focus at all distances without any difficulty. This focusing ability decreases as a person approaches middle age, and by the age of 45 most people are unable to focus clearly any small objects nearer than arm's length without the use of spectacles.

A person's reading glasses have to be made stronger from time to time as the range of clear vision with the glasses becomes shorter. From the age of about 55 onwards a person who does exceptionally fine work or has to work at an unusually close distance may need special spectacles different from his ordinary reading spectacles. Similarly, an older person who has to view objects or instruments at a distance rather farther away than the ordinary reading distance may require help. It is clear, therefore, that as more older workers are persuaded to remain at work, the provision of special working spectacles will become an increasingly important factor in the maintenance of the capacity and fitness to work.

In factories the working conditions vary very greatly, and workers have to be able to see clearly at many different working distances. This means that each worker's visual problem may be different, and in some cases it is essential for the optician to know the details of the particular process or operation in order to be in a position to help his patient meet fully the visual requirements. A typical example is a man working a Monotype keyboard. He has to be able to read his copy, scan his keys, and watch the movement of a small drum at the top of the machine which indicates the spacing required to fill each line. Another good illustration is a tailor's cutter in a tailoring factory. As he uses his cutting machine to run along the white chalk lines marked out on the cloth, one moment he is working near to himself and the next moment he is working at the far end of the piece of cloth. This constant change of working distance will probably present a problem to a person over 55. Again, the working distance of the tailor's cutter depends on his height, since the height of the working bench is usually fixed. A bench that could be adjusted for height and was capable of being tilted would be of great assistance. Or a short cutter could be assisted by giving him a platform on which to stand.

Highly skilled workers, and their employers, tend to belittle the part played by visual ability and assert that their skill reduces the importance of the visual factor. This is true to a limited extent but is dangerous if carried very far and it is only common sense to back up skill with the best possible vision. A worker whose sight causes discomfort is not a happy worker and sooner or later will become an inefficient worker. From middle age onwards there is a growing probability of visual discomfort. To quote Sir Stewart Duke-Elder: "Of all the ailments which interfere with the smooth running of the human machine, eyestrain in one form or another is probably the most common."

Efficiency in a worker is not merely the ability to produce goods. Since a worker may be able to borrow from one skill to make up a deficiency in another he may be able to continue to produce satisfactory work. The visual difficulty may cause other trouble, however, for example the worker may become accident-prone, endangering his own safety and that of his workmates. Every case of accident-proneness should have a full visual investigation.

Without light there can be no vision, and visual ability is directly affected by the standard of lighting employed. Nothing that we can do in the way of professional attention to workers' eyes can replace a deficiency in lighting. It is not merely a question of adequate illumination; the important thing is to provide correct lighting and lighting designed for the particular circumstances. Good lighting is even

more important for older workers and for people with slightly sub-normal vision.

There are many aids to vision in common use in industry and there is scope for further development in this respect. Most of these aids are employed to help normal-sighted persons perform difficult or intricate jobs, but these aids are also very useful in the case of persons with reduced visual ability. One example is the use of auto-setting on machines; another the wide use of jigs. Pin gauges and plug gauges are used in many factories. These are checked very accurately by means of a vernier microscope, and thus the accuracy of the work in the entire factory can be controlled from the test room. Pin gauges are very simple to use and obviate the need for each worker to use micrometers or other measuring devices. An obvious aid for older workers is a magnifier suitably mounted over the job.

Referring to drivers of vehicles and locomotives Mr. Wells said that a person who is long-sighted may have sufficiently good distance vision to pass the usual vision tests but he may be able to maintain this good vision only by the exercise of considerable extra nervous effort. Such conditions may cause drowsiness, headaches, etc., and are inadvisable for anybody driving a vehicle of any kind, particularly an express train.

In conclusion Mr. Wells said that there can be no doubt that further study is desirable of the visual problems of older workers in industry. Much could be done immediately but of greater importance was a long-term plan with the co-operation of employers.

Lamp Column Design

A few weeks ago *The Times* carried a letter the author of which complained that " Parliament Square has the most miserable, emaciated collection of lamp-posts—cheap and nasty—to be found in any similar central square in the country." The writer suggested that the columns in the Place de la Concorde in Paris might " be an example to those who have erected these drainpipes." A few days later another correspondent stated that in his opinion " not only are the new lamp standards an immense improvement on the Victorian cast-iron bulbosities they replace but they are excellent examples of contemporary civic designs " and suggested that the design is one that deserves wider imitation.

Readers of *Light and Lighting* will be aware of our interest in the design of lamp columns, but we were particularly interested in the correspondence quoted above, especially the first letter, as only a day or two previously we had been looking at the columns in Parliament Square and had felt how well they seemed to fit into their surroundings. We were not so certain when they were first erected, but now that we have got used to the new layout of the Square we cannot but agree with the writer of the second letter.

Parliament Square.

Place de la Concorde.

As far as the Place de la Concorde is concerned, we feel that the columns there would be as out of place in Parliament Square as the Parliament Square columns would be in the Place de la Concorde. Photographs of both columns are reproduced on this page; readers might like to let us have their own comments. Incidentally, the Parliament Square columns (and the lanterns) were designed by Grey Wornum.

Lighting at the Coronation

Our August issue was devoted to a pictorial record of lighting at the Coronation, and appreciations of the issue were received from many parts of the world. At that time it was not possible to deal with the design of any of the installations in detail, but since then the Ministry of Works has collated the technical details of the lighting for which it was responsible. We feel sure that this report, particularly the section dealing with the interior of the Abbey itself, will be of great interest dealing as it does with the problems which faced the engineers of the Ministry and the methods by which the problems were solved. In illustrating this report we have reproduced only a few of the illustrations used previously but have included a number of hitherto unpublished pictures.

Fig. 1. *Procession leaving the Abbey.*

(1) Lighting in the Abbey

The lighting system installed for the Coronation on June 2, 1953, was based primarily on that used for the Coronation in 1937, when it consisted of 500-watt reflectors situated in alternate arches of the triforium throughout the length of the nave with similar treatment around the theatre. The illumination provided by this arrangement was of the order of 15 lm./ft.^{2} in the nave and 30 lm./ft.^{2} over very limited areas of the theatre.

Critical examination of photographs and films taken at the time revealed that at least twice as much light would be required and more attention would have to be paid to the angles of light, to provide film and photographic records up to modern standards. Such a modification would not have been difficult for normal black and white films and television with the more efficient lighting equipment now available, which together with improved photographic technique would have been adequate. But the requirements of colour cinematography, with the greatly increased illumination necessary, introduced the problem of providing lighting without causing discomfort by glare or temperature, which were both limiting factors. It was essential, also, that the lighting equipment should be unobtrusive.

Experiments for Intensity and Shadow Elimination

Experiments were carried out in conjunction with the film companies to ascertain the minimum illumination necessary to produce a reasonably good colour film and this was found to be 120 lm./ft.^{2}.

It was seen in the photographs and films taken in 1937 with 30 lm./ft.^{2} that facial shadows at times almost obliterated the features; increasing the illumination value to 120 lm./ft.^{2} with almost vertical lighting would have intensified this defect by increased contrast. When coronets were worn, the faces of persons wearing them appeared as black patches in an otherwise good colour film. In an attempt to rectify this fault the projectors were positioned so as to obtain an oblique angle in each direction along the axis of the nave. It was found that this angle had to be at least 30 deg. if the shadows were to be reduced sufficiently for features of people to be recognisable. Because of the long sight-line over the length of the nave, the projectors at this angle produced a glare which would not have been acceptable. A suggestion to have batteries of four 150-watt silvered lamps at low level attached to each of the piers in the nave was tried and abandoned on account of the discomfort produced. An alternative suggestion to use clusters of 500-watt Photo Pearl lamps in pendants was also tried experimentally with encouraging results.

To produce a good picture (in colour especially) of the procession in the nave it was necessary to have adequate lighting not only in the aisle but also over the assembled guests with their colourful background. The pendant fittings did this admirably and relieved the facial shadows satisfactorily. An eight-light corona pendant with opaque reflectors was tried, but in addition to its industrial appearance which was quite out of place in the Abbey, it did not allow for any upward lighting, essential for effect if daylight was poor. As an alternative the Abbey chandeliers were tried, the six arms carrying the vertical lamps and shades being reversed so that the lamps could be suspended. To these arms were attached Holophane prismatic glass reflectors (Type X.200) in which the 500-watt Photo Pearl lamps were placed.

Fig. 2. Type of projector used in the Abbey.

This arrangement proved very successful because the Abbey chandeliers which form part of the building were retained and sufficient light both downward and upward was provided. It was found, however, that the satin finish of the white glass introduced an undesirable brightness which was out of harmony with the brass of the chandeliers. This was overcome by treating the glass with a gold lacquer, fired to make the colour permanent and to withstand the heat of the 500-watt lamps.

The inclement weather on Coronation Day would normally have caused the upper portion of the Abbey to be gloomy, but the upward light from the chandeliers produced a golden glow over the whole scene. The modification also reduced the apparent brightness of the reflectors.

Guarding Against Accidents

The reflectors were designed for use with 200-watt G.S. lamps and supported by the normal canopy and gallery screws. A 500-watt Photo Pearl lamp has approximately the same dimensions as a 200-watt G.S. lamp but runs at a much higher temperature. It was visualised that the expansion caused by this additional heat could result in a fracture, and no such risk could be taken. An inconspicuous wire cage was therefore designed which carried the weight of the reflector on the rim, leaving the neck complete freedom to expand and at the same time giving ample ventilation to the lamp. An almost invisible wire mesh was attached to the underside of the cage for protection in the event of lamp breakage. No fracture

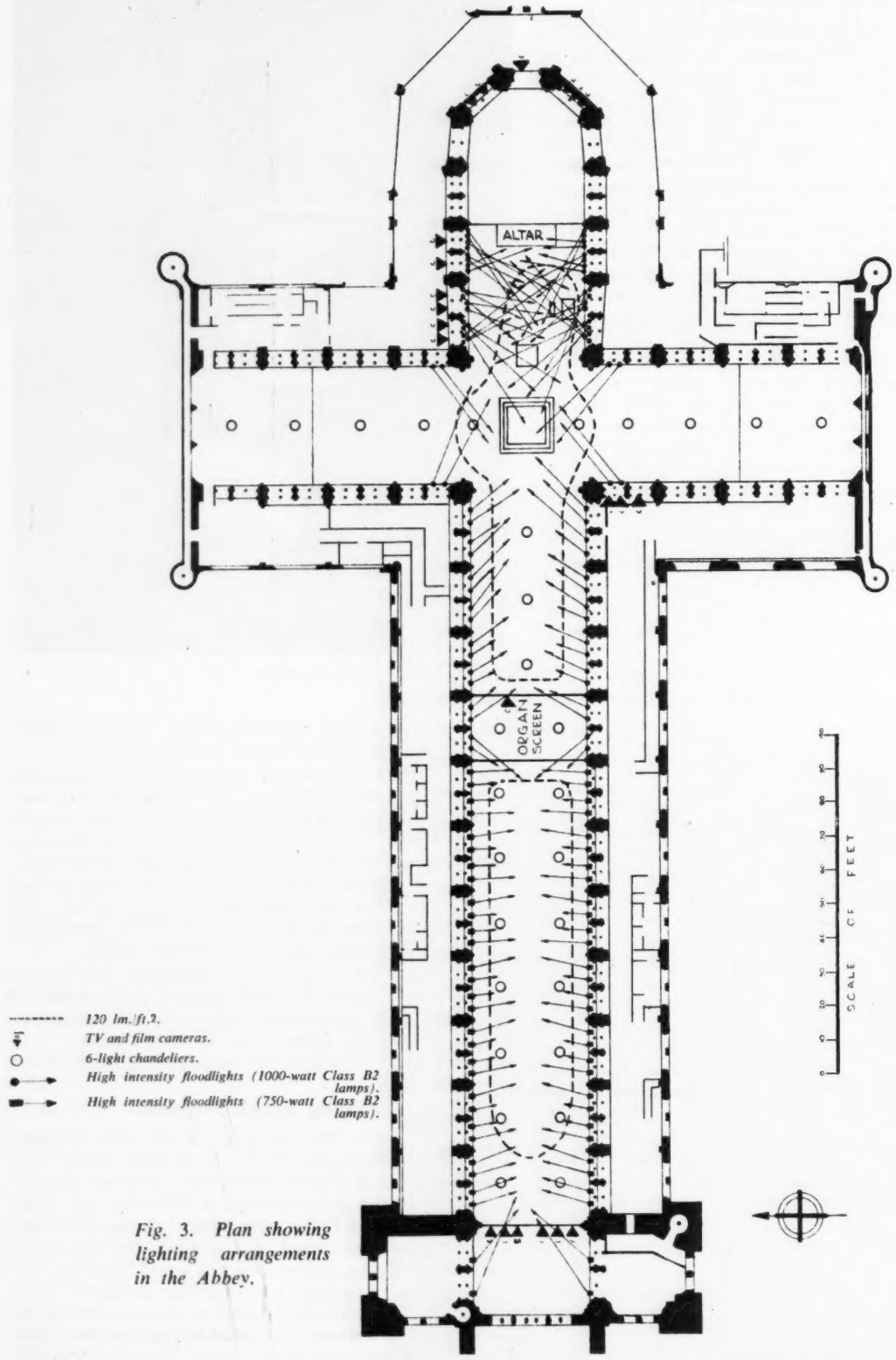


Fig. 3. Plan showing lighting arrangements in the Abbey.

of lamps or reflectors occurred but this safeguard was an essential requirement.

There were two rows of eight chandeliers between the West Door and organ screen; these produced an illumination of 60 lm./ft.^{2} over the aisle spreading well over the adjacent seating. Being suspended at a height of 30 ft. from the floor the fittings were not disturbing even to those in the higher stands.

A point worthy of mention is that the chandeliers drew attention away from the projectors at triforium level and so formed an effective "screen."

The chandeliers over the organ and in the choir were at a higher level for better distribution over the orchestra, whilst those in the transepts were sloped on a line up to the centre of the rose window parallel with the tiers of seating.

The Nave

The additional illumination required to build up the centre of the nave to 120 lm./ft.^{2} was provided by Holophane projectors, one in each of the triforium openings, with a total of 60 in the section of the Abbey west of the organ screen. All were at a height of 60 ft. from the floor. These projectors consisted of a highly polished aluminium parabolic reflector contained in a standard floodlight housing. The lamps used were 750-watt Class B2 projector type. It was found that the cut-off angle of the reflector did not shield the direct vision of the filament sufficiently to prevent side angle glare. To overcome this a concentric louvre (or spill ring) was designed which contained a prismatic glass diffusing dish. The effect of this combination prevented the direct view of the filament from any direction and annoying stray light was eliminated.

The mouth of the projector units was covered with ¾-in. wire mesh in case of lamp fracture. The light loss due to the screening and protection was some 25 per cent., but this sacrifice was necessary to ensure freedom from glare of exposed filaments and to ensure safety.

The majority of the projectors were angled to approximately 20 deg. towards the organ screen. The purpose of this arrangement was that the light should fall as obliquely as possible without undue glare towards the outgoing procession in order to assist the cameras situated over the West Door.

The Theatre

The theatre presented problems more difficult of solution than those in the nave. For example there were four camera positions to be considered; two diametrically opposite each other at low level, one on the organ screen facing east and one in the triforium facing west. Whereas in the nave all projectors could be angled in one direction to serve one camera position, in this case each of the four positions had to be provided for.

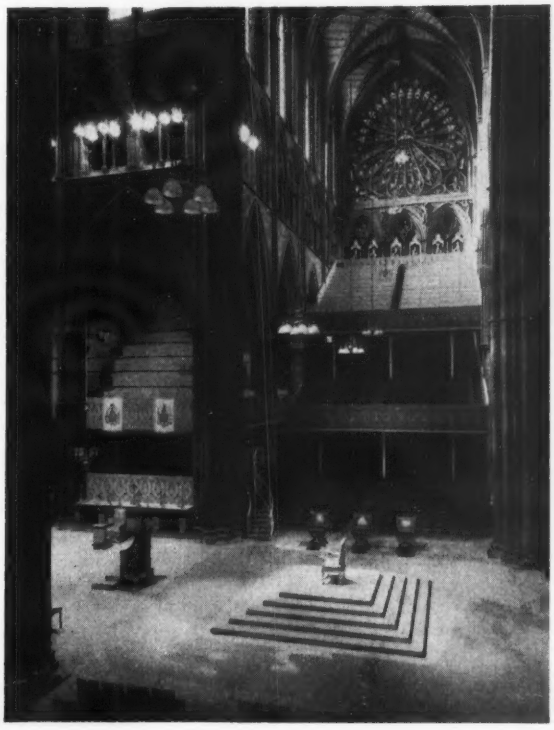
It was even more essential in this important area for facial shadows to be kept to a minimum, and little assistance could be derived from the chandeliers. There were only two chandeliers in this area, on either side of the throne. Practically the whole of the sanctuary lighting had to be done from triforium level.

As the view of the projectors in the theatre was foreshortened, it was possible in this area to increase the oblique angle to 30 deg. and so obtain cross-lighting without discomfort.

A total of 50 projectors similar to those in the nave

Fig. 4. View of nave from triforium level showing projectors.

Fig. 5. The Theatre.



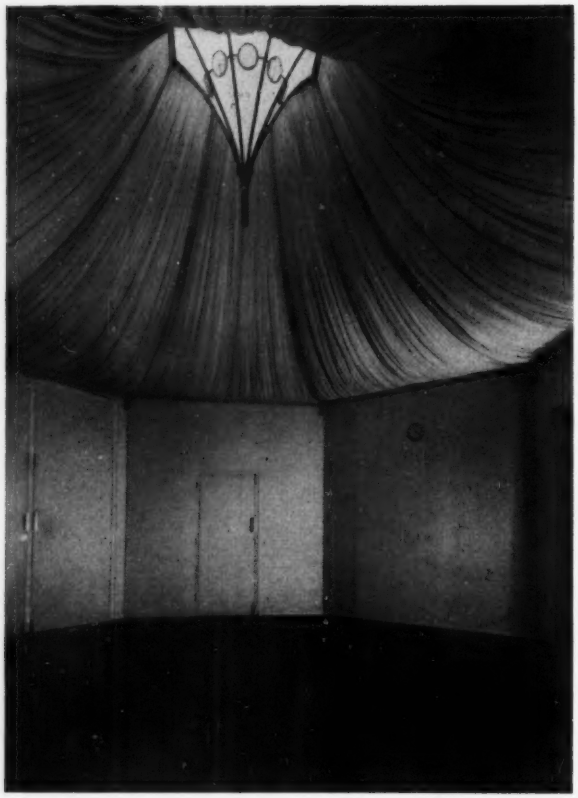


Fig. 6. The vestibule of the Annexe.

were employed in the theatre, 30 in the sanctuary and 20 in the crossing, each containing a 1,000-watt Class B2 lamp. These projectors produced a very concentrated beam. The "spot" at floor level was about 7 ft. in diameter at 30 lm./ft.^{2}, tapering to 10 lm./ft.^{2} at 10 ft. in diameter. It will be appreciated, therefore, that over the important areas four beams had to be superimposed. This was done where possible from four opposing positions, the beams crossing at a height of about 5 ft. from the floor. By this arrangement much of the shadow was effectively cancelled out, and the successful results obtained were largely due to the intricate pattern of interlacing beams.

St. Edward's Chair

Intermediate areas, for example between St. Edward's Chair and Altar and around the Chair of Estate, were covered as far as possible at 120 lm./ft.^{2} in order that the various parts of the ceremony could be filmed and televised from any of the four camera positions.

A limited amount of low-level lighting was used on St. Edward's Chair. This consisted of eight 150-watt internally silvered lamps in louvred housings. Four were mounted at about 20 ft. from the floor on the stanchions carrying the staircase to the stands above the Royal Gallery and the tombs opposite, respectively. The angle of this lighting was about 30 deg. with an average throw of 40 ft., producing 10 lm./ft.^{2} vertical illumination at the chair position.

The Throne

The lighting for the throne was carried out from the four corners of the crossing in a similar manner to the sanctuary, and was assisted by the two chandeliers previously mentioned. Here again as large an area as possible was covered at 120 lm./ft.^{2} : in addition provision was made to have sufficient illumination for filming purposes around the chairs occupied by the Royal Dukes. A few projectors over the north choir were diverted for this purpose, and these also considerably assisted the filming of the return procession.

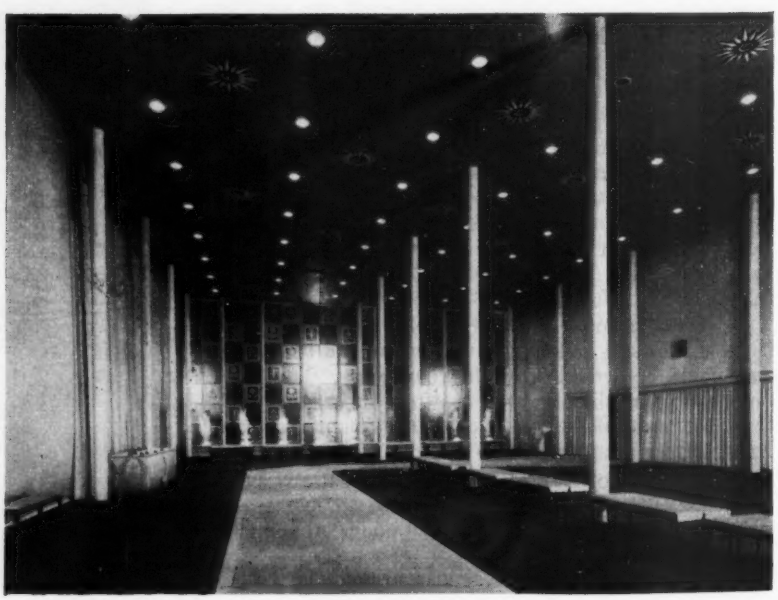


Fig. 7. The main assembly hall of the Annexe.

Lighting Control

The lighting control was carried out from one central position situated in the triforium over the high altar. From here it was possible to observe the progress of the ceremony and to keep watch for any possible failure of the lighting equipment or supply.

There were six other switchboard positions, each linked by telephone (through the Abbey exchange) with the central control. Two of these switchboards had cue lights in addition, where synchronisation of the switching operation was necessary.

The only variation of lighting intensity took place in the nave in which area it was unnecessary to maintain the full lighting during the ceremony. All the chandeliers in the nave were controlled by a three-phase variable auto transformer which allowed for a gradual variation of voltage from 230 to 160 volts. This method of control was preferable to a resistance type dimmer as there was no generation of heat whilst in the " Dim " position. At the lowest position the chandeliers had a brightness appearance equivalent to that obtained with ordinary 200-watt lamps.

On the completion of the principal procession every alternate projector in the nave was switched off and the luminous intensity of the chandeliers was then gradually reduced. Before the return procession commenced a reverse procedure took place so that full illumination was available for its filming.

In the event of mains failure it would have been possible to have switched over the total load of the Abbey to standby diesel-driven generators in less than 30 seconds.

Temperature rise with such a high level of illumination was carefully checked. It was found that it accounted for only a few degrees' rise above the ambient temperature. It was also found to be lower by using a larger number of smaller units as compared with the equivalent intensity produced by fewer units using high-power lamps.

The Royal Gallery

The Royal Gallery was prominent in various films taken of the ceremony, and appropriate lighting was necessary in this position. It was not practicable to provide 120 lm./ft.^{2} here, but rather less than half this amount was produced by lines of architectural lamps contained in a recess formed in the ceiling. This was assisted by the general reflection from the floor which was covered with a golden coloured carpet having a high reflection factor.

The Annexe

The annexe which formed the principal entrance to the Abbey contained the vestibule, main assembly hall, Royal retiring rooms, peers' robing rooms, etc.; all of these required appropriate treatment as regards lighting. Being modern in character the architectural design of the building called for contemporary lighting fittings to provide a harmonious relationship, bearing in mind also the particular purpose for which the lighting was required.

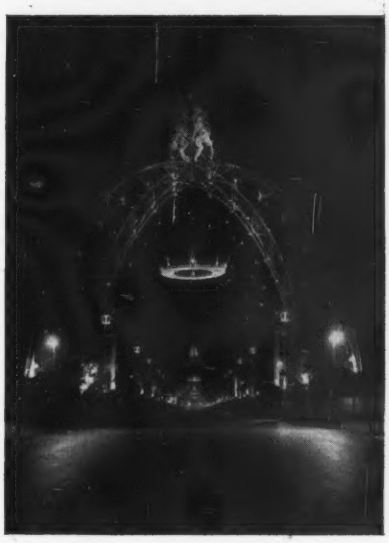
The fitting in the vestibule was designed to merge with the tented velarium ceiling and was a trumpet-shaped frame supporting a stretched silk lining. It contained 24 40-watt lamps as well as one 150-watt pilot lamp.

The main assembly hall, being 100 ft. x 60 ft. x 25 ft. high, required careful consideration if its spacious appearance was to be preserved. Suspended fittings would have been too obstrusive because of the number required to light this large area. It was decided to have all lighting units sunk flush in the suspended ceiling. These units consisted of aluminium reflectors, each containing a 200-watt lamp screened by concentric louvres which, being gilded, were effective against the surrounding red ceiling. Sixty such units were evenly spaced over the whole room, producing a uniform illumination of 10 lm./ft.^{2}. A much higher value was, however, required to give emphasis and sparkle to the regalia table. This was done by using 500-watt clear photographic lamps in the two units over this area.

Many suggestions were considered for lighting the Royal retiring rooms, including the use of traditional chandeliers; it was decided, however, that the modern trend should prevail throughout and the eventual choice fell upon those in the " Versalux " range by Troughton and Young.

In certain of the smaller rooms a louvred internally silvered 150-watt lamp was incorporated in the ceiling. Lighting for the dressing-table and cheval mirrors received particular attention, and a number of " Versalux " adjustable floor and table standards were used for this purpose. The peers' hall and refreshment room was illuminated by flush louvre fittings, with 150-watt silvered flood lamps.

(2) Decorative Lighting



The Mall

The decorative treatment of the Mall undoubtedly produced the show-piece of the Coronation route. The four triumphal arches spanning the carriageway at some 750-ft. intervals were the dominant features in a simple scheme, the decoration of which relied to a large extent upon their structural elements. In designing the arch, equal attention was given to the effect produced by night as by day, using shapes, materials and colours to give the desired result.

The arches were parabolic in shape and consisted of four limbs which converged at an apex 65 ft. above the carriageway. Surmounting each of these arches were two pairs of lion and unicorn emblems, 17 ft. in height,

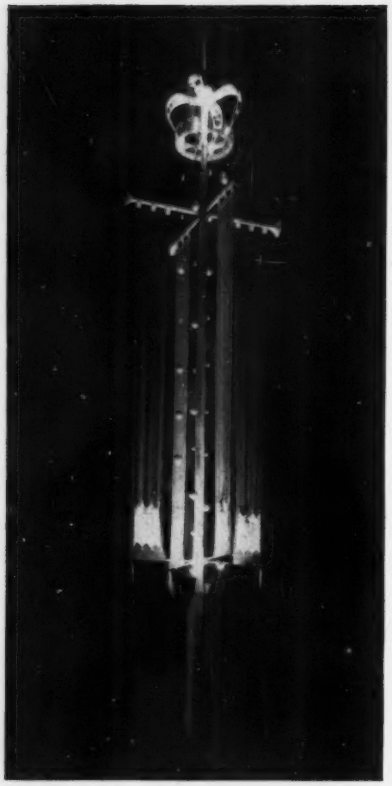


Fig. 8. Banners in the Mall.

Fig. 9. Showing housings for reflector lamp on the arches.

supporting a central shaft which terminated in a ball and spike finial. A princess's coronet, 16 ft. in diameter, was given a floating effect within the arch formation, being suspended by a series of wire cables on which were threaded bright metallic witch balls, which reflected both sunlight and artificial light.

The principal framework outlines of the lion and unicorn emblems consisted of tubular members (in keeping with the main construction) with a lattice infilling, finished with high reflectivity metallic paint in the traditional colours of gold and silver. The openness of the design produced the same success by night as during the day, differing only in appearance by the fact that in daylight it was dark against light, whilst at night it was light against a dark background.

At night the framework intercepted the light which was projected vertically from lamps concealed immediately below and produced a brilliant outline to all the features, whilst the lattice infilling was less bright owing to its flat surface. The effect of this light and shade contrast gave the required modelling to the beasts. No light reached the reverse side of the lattice work, so that when the emblems were viewed from a position at right angles to

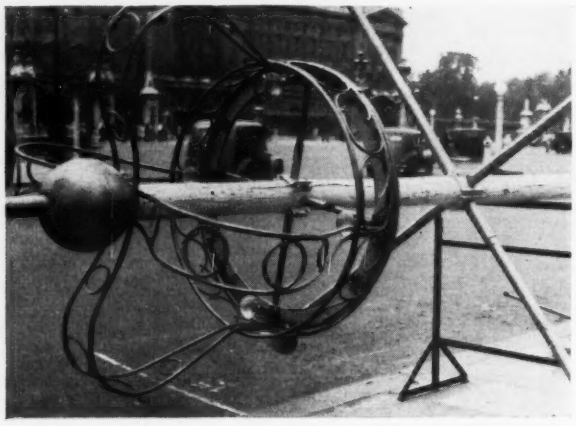


Fig. 10. Showing arrangement of reflector lamps in the crowns (Fig. 8).

the Mall the bright outlines only were seen and gave the effect of lighting with luminous tubes.

The coronets were constructed of tubular steel with cane infilling finished in gold paint, and the inset " jewels " below each of the four Maltese crosses and four fleurs-de-lis were shaped, painted metal panels. The lighting (from lamps concealed in the lower portion of the limbs) produced the effect of a delicate golden engraving against the night sky. This was more effective than the result which would have been obtained if the coronets had been fabricated in sheet material. The fan-shaped motifs applied to the limbs of the arches were also of cane, and these, together with witch balls, received sufficient light from the spill of the 500-watt lamps mentioned later. The lighting of the finial presented a problem, because the size of the ball prevented light reaching the spike. This was overcome by housing lamps within the hollow ball and projecting up the spike through an annular opening around the shaft. The internally silvered lamps which were so extensively used, not only in the Mall but in many other situations, proved

their worth for these forms of lighting. Their physical size enabled a powerful light beam to be projected from within a much smaller space than that which would be required by a reflector and lamp combination of the same light output. Initial costs were also lower and, in addition, the difficulty of finding a use or storage space for redundant reflectors after the event was avoided.

A trial arch was erected in Regent's Park, which enabled the many necessary experiments to be carried out, but for various reasons at no time was it possible to see the complete effect on a fully dressed and illuminated arch.

The final solution to the lighting problem was surprisingly simple. In each of the four limbs, at a height of 12 ft. from the ground, two 500-watt internally silvered reflector lamps were contained within separate special-shaped sheet metal housings which were adjustable for angle up to a limited degree. These served to illuminate the coronet, the witch balls on the supporting cable and the decoration of the arch itself. Immediately below the foot of the lion and unicorn emblems six 150-watt silvered lamps were positioned on either side of the double motif (12 lamps in all). These also were contained in metal housings of special design.

No provision for weathering was necessary apart from preventing ingress of water into the lamp-holders as the hard glass from which the 500-watt lamps are made permits them to be used externally without protection. Hard glass lamps of the 150-watt size were not available, and the standard pattern when hot would have been fractured by rain unless provided with some form of protection. In this case it was provided by means of a special silica grease applied to the face of the lamp, which prevented water making actual contact with the glass. Two 75-watt silvered lamps similarly treated were used in the finial.

Visual continuity between the four arches spanning the Mall was provided by a series of poles (47 in all) carrying banners and surmounted by a crown 3 ft. 6 in. in diameter. These wooden poles were 40 ft. high, and each carried four red banners 19 ft. long with the Royal cipher in yellow at the lower end. These banners were suspended from four cross arms, in the shape of trumpets positioned just below the crown, and were held at the bottom to prevent movement. In each of the four right angles formed by the banners there was a vertical wire carrying witch balls of varying sizes suspended over the lighting fittings. These balls were arranged in such a manner that each received light without the presence of undesirable shadows. The lighting elements for the banners consisted of one 150-watt internally silvered reflector lamp concealed in a decorative metal spinning supported on a cross arm between, and slightly below, each of the four banners. The mouth of each spinning was cut at an angle to produce a symmetrical shape, and the size was determined by architectural considerations and not as a result of the dimensions of the lamp it contained. The weather protection in these units was provided by means of a disc of heat-resisting glass, as this gave mechanical protection (required at this low level) to the lamps, besides acting as a water shed. The four 150-watt silvered lamps gave ample illumination to the full height of the banners and picked out brilliantly the gilt trumpets at the top.

In the base of the crowns were four 75-watt silvered lamps projected upwards and, owing to their being adjacent to the objects to be illuminated, they provided the high light necessary to form the luminous link between the arches. These 75-watt lamps were silica-grease treated, and the necks were black-sprayed to prevent the filaments being seen from below. It would seem incredible that the wonderful spectacle produced in the Mall by the illuminated arches and banners could have been accomplished by such simple equipment. As previously mentioned, the explanation for this lies in the method of construction and types of materials employed, together with the application of correct angular relationships between the light sources and the objects illuminated.

The control of lighting was so arranged that the four arches were switched on in sequence, beginning with the arch by Buckingham Palace and following eastwards at one second intervals. The rows of intervening banner poles were switched in unison. The control of the arches was effected by means of contactors having a mechanical time delay mechanism which by appropriate adjustment allowed for the one second delay between the switching of individual arches. The switching of the intervening rows of banners was also carried out by contactors but in this case their operating coils were energised when the arch circuits became alive.

This scheme produced a spectacular "wave of light" effect, which, at its termination by Admiralty Arch, provided the cue to observers for switching on the "Floodlighting of London." Her Majesty the Queen initiated this operation at 9.45 p.m., on June 2, 1953, by closing a switch situated on the balcony at Buckingham Palace. On subsequent nights the control was by a time-switch.

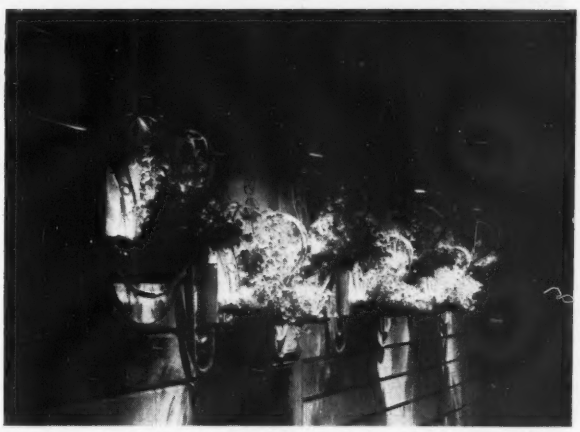


Fig. 11. Floral decoration at the Duke of York's Steps.

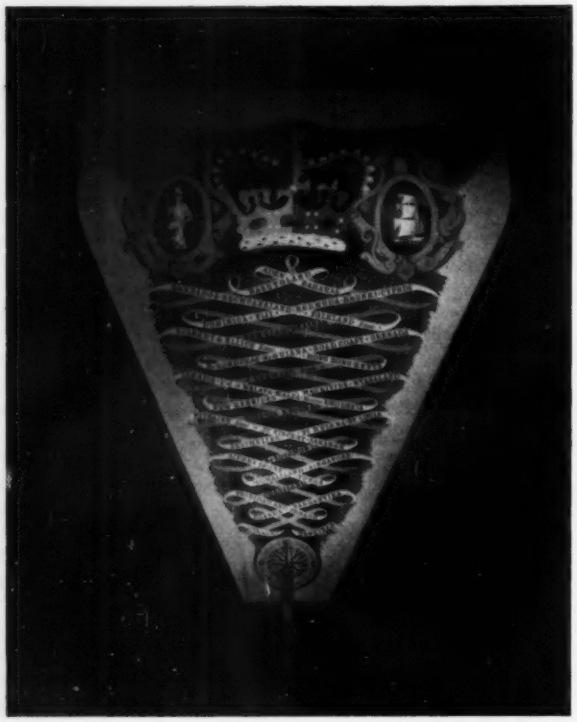
There was complete co-operation between the responsible architects and engineers at all stages throughout the designs from the illuminated scale models to the complete lighting schemes.

In order to provide for a load of 90 kw. required for illuminating the decorations in the Mall together with an adequate supply to meet the needs of the B.B.C., public address system, and miscellaneous requirements, it was necessary to install new feeders throughout the length of this thoroughfare. These new feeders, which were installed by the London Electricity Board (utilising existing ducts), provided a 400/230-volt three-phase supply to each of the 12 distribution positions situated along the route at convenient positions for distribution.

At each of these points a weatherproof cubicle was

Fig. 12. *Stand in Parliament Square.*

Fig. 13. *Crown Colonies and Protectorates motif on the Commonwealth Stand in the centre of Parliament Square.*



erected under the stands which contained the control and distribution equipment together with the supply meters. From these cubicles the distribution was carried out by three-core T.R.S. cables either overhead or underground as necessary.

All the banner poles were fed from overhead lines taken through the trees with "T" joints opposite each pole, whilst the supply to the arches was taken by underground conduit to the base of one leg and thence through the tubular steel members of the arches. The wiring of the arches presented technical problems as these structures arrived in sections for assembly on site. Special ways were provided through the joints in the tubular members to allow the cables to be drawn through without injury to the insulation.

Precise co-ordination between the electrical and mechanical interests involved in this undertaking enabled the erection work to proceed smoothly. Much of the wiring work was carried out on the ground, leaving only the fixing of lighting units and connecting up, after the erection of the arches had been completed.

Trafalgar Square

Only a small amount of lighting was carried out in this area apart from the floodlighting of the National Gallery.

A new lighting scheme was arranged for the flower beds on the north side of the square and each was provided with five "mushroom" standards comprising 24-in. diameter bronzed bowls containing eight 60-watt lamps. The bowls were supported on 2-in diameter standards 4 ft. high. The lighting of the fountain was retained in white lighting as previously, this being considered the most effective display for this occasion.

A novel arrangement for continuously flashing in morse code the message "Long May She Reign" was installed on the roof of the National Gallery. It consisted of a 14-in. opal sphere, containing a 150-watt lamp, mounted on a suitable tripod. From this position it could be seen from many points in the surrounding area.

Whitehall

It was the intention in this important area to confine the lighting as far as possible to the decorative features rather than to floodlight the buildings generally. The decorations for each building were designed to depict in emblematic form the activities of the particular department in occupation and this resulted in a variety of decorative schemes each requiring individual treatment in respect of lighting arrangements.

Most of the motifs were dealt with separately in order to make them stand out prominently against the background of the buildings. Here, as in the Mall, extensive use was made of internally silvered reflector lamps of 75-, 150- and 500-watt sizes. These were concealed in a variety of ways, viz., as an integral part of the motif, from window balustrades, from behind the stand frontals at ground level (long projection with 500-watt lamps), etc. Certain of the floral decorations of window sills and cornices were illuminated with ordinary 40-watt general service tungsten lamps spaced at 12-in. centres and placed below the flowers, thereby providing the necessary diversity of interest. In one or two isolated instances only were fluorescent lamps employed.

Exceptions to the individual method of lighting were

to be found in the case of the First Lord of the Admiralty's residence, the Admiralty building itself, and Whitehall elevation of Horse Guards. In these instances floodlighting was used as a background in a very effective manner besides illuminating the mass of flags incorporated in the decorations.

Flags flying at roof level on certain buildings on the west side of Whitehall were individually lighted by means of 500-watt internally silvered reflector lamps placed on adjacent roof areas. On the east side, however, this provision was unnecessary, as the upper portions of the principal buildings were illuminated by means of long-range projectors situated on the roofs of opposite buildings. The purpose of this was two-fold: (1) to illuminate the flags and motifs at high level, and (2) to high-light the architectural features visible from Buckingham Palace and St. James's Park so as to form part of the illuminated skyline.

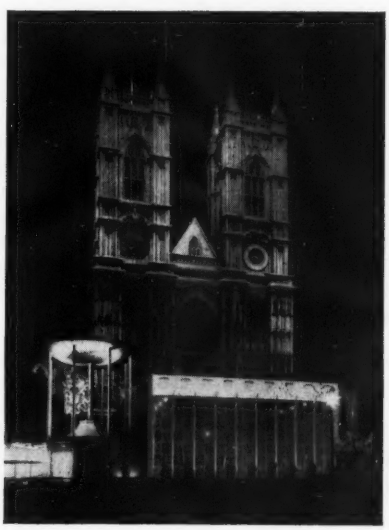
Parliament Square

The stand in Parliament Square (reserved for Dominion visitors) was built around the periphery of the square and was bordered with flowers arranged in kerb-side beds and in boxes. The floral decorations were illuminated with 40-watt general service lamps concealed amongst the flowers, local 150-watt spot lights in metal housings, or 500-watt internally silvered reflector lamps arranged in the foliage of trees on the west side of the square.

For the general lighting of the underside of the stand covers three 1-kw. wide angle floodlights were installed on each of the four sides. The Dominion plaques and crowns, which formed the decorative motif, were each illuminated by one 500-watt reflector lamp suitably concealed from view.

A row of banners arranged in New Palace Yard (flanking Bridge Street) were each illuminated by means of two 500-watt internally silvered reflector lamps, installed at ground level. The spill light from these lamps illuminated the adjacent trees, which formed an interesting foreground to the Clock Tower.

(3) Floodlighting



The floodlighting programme for the Coronation period was arranged not only to produce a more comprehensive scheme than had been attempted before, but also to introduce new features, all of which had to be effected within the financial limits imposed.

The Royal Palaces in London and such well-known buildings as the Tower of London, Somerset House, etc., were unaltered as regards treatment, as few improvements on previous schemes could be made. One of the principal innovations which proved of great interest was the illuminated skyline, the purpose of which was to produce an illuminated panorama when viewed from Buckingham Palace and St. James's Park. This was accomplished by lighting the upper portions of the most prominent public buildings in Whitehall, viz., Foreign Office, War Office, New Government Offices, Whitehall Gardens and Banqueting Hall.

The lighting of the Horse Guards was modified to aid this effect by elevating the long-range projectors to emphasise the upper portion of the façade.

The floodlighting of Carlton House Terrace was a new feature, and the silhouettes of the columns gave an added distinction to this classical façade. In addition, this high brightness area helped in no small way to link the illumination in the Mall with Admiralty Arch and the panorama generally. The statue of the Duke of York was lighted by two 5-kw. long-range projectors, which provided the continuity between the east and west elevations of Carlton House Terrace.

The lighting of the clock tower of the Houses of Parliament was considerably improved, the distant view in particular, by the introduction of 28 300-watt floodlights arranged around the balcony above the clock face, so bringing into high relief the arches of the belfry.

In addition, some special high-power long-range projectors were installed at roof level on the new public office (corner of Parliament Square) to high-light the pinnacles and cross. The result was helpful, but the brilliant effect desired could not be produced owing to the weathered condition of the metal crockets and cross.

The Abbey, being the setting of the Coronation ceremony, was a focal point for the multitude of visitors who thronged the route, and it was fitting that special attention should be paid to its floodlighting.

Most of the lower portion of the building was obscured by stands, so all the equipment normally used for lighting this was rearranged to boost the illumination at triforium level, thus giving the desired "floating" effect. The lighting on the west towers was also augmented in a similar manner, and the pinnacles which surmount them were individually lighted by local 500-watt reflectors. The emphasis given to the pinnacles thereby not only gave the necessary accentuation for the distant view but resulted in a perspective effect in addition. Not since the Coronation of 1937 has Henry VII's Chapel been floodlit, and the wealth of architectural detail which adorns this building made it a worthy subject for such treatment. It also helped to define the total elevation of the Abbey, the east end of which would otherwise have tended to become lost among the trees.

The tower of St. Margaret's Church showing as it did above the high stands was illuminated by means of 5-kw.

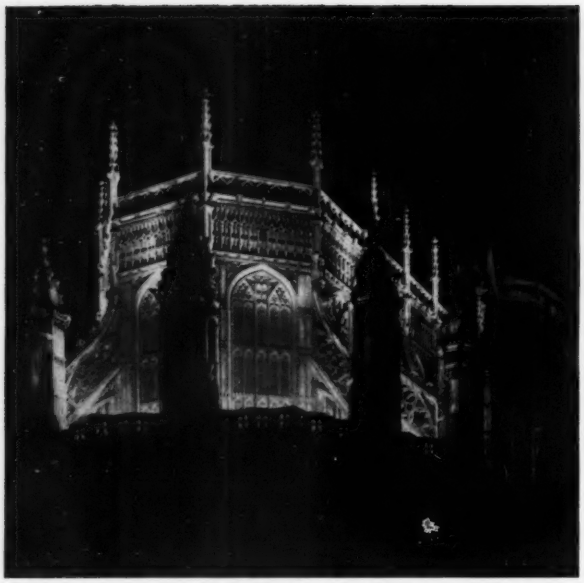
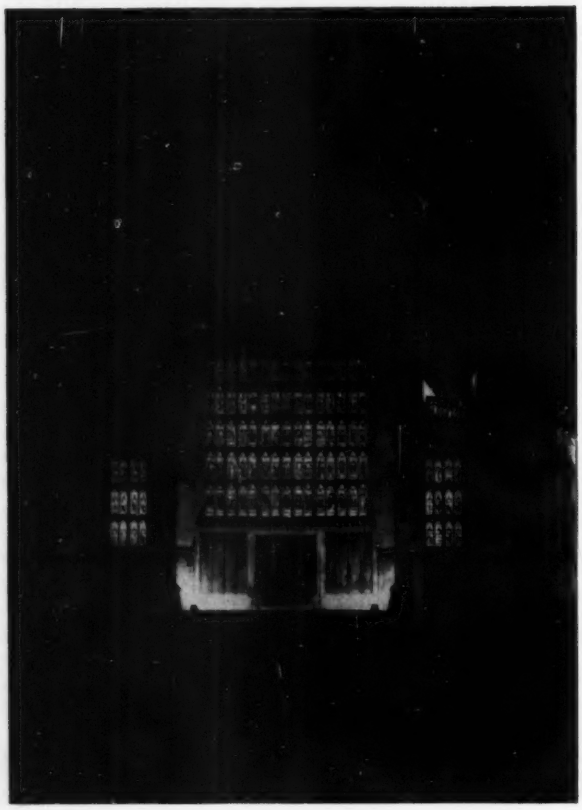


Fig. 14. *Henry VII's Chapel.*

Fig. 15. *St. George's Chapel, Windsor.*



long range projectors from within the stands erected in the centre of Parliament Square. The effect of this was to break the line of dark trees and make a useful contribution to the Abbey scheme.

The annexe, a temporary addition to the Abbey, was also of public interest and the principal features were the octagonal entrance and the large west window with the row of Queen's Beasts in front. Above the entrance was the Royal Coat of Arms suspended below a circular canopy having a blue valarium ceiling. The very effective lighting of this motif was carried out in a simple manner by means of ten 150-watt internally silvered reflector lamps concealed behind a low parapet surrounding the roof of the vestibule. In order to minimise the shadow on the valarium ceiling three similar lamps were attached to the back of the motif. Placed around the base of the flag mast were four 150-watt internally silvered reflector lamps. After the Coronation, two 150-watt spot light fittings were attached to the underside of the "Perspex" canopy to illuminate the main entrance doors.

A silhouette effect was given to the Queen's Beasts by means of one 150-watt reflector lamp sunk into the platform behind each cast; these lamps also illuminated the heavy mullions and the obscured glass panels in the window. In addition they illuminated the heraldic panels on the sloping facia above the window. A certain amount of colour was given to the window panels at night by reflection from the low brightness red ceiling within.

At no time previously has so much of the exterior of Windsor Castle building been floodlit. The present scheme was designed to include portions of the Castle seen from Windsor High Street, viz., Curfew and Salisbury Towers, with the intervening battlements leading to Henry VIII's Gate and beyond up Castle Hill towards Sovereign's Entrance.

The method adopted for the periphery of the Castle was that the individual towers were illuminated with tungsten lamps and the intermediate flanks with more widely spaced sodium units. The reason for the increased spacing over that previously used was to reduce the surface brightness to a point at which the colour did not conflict too vividly with the tungsten lighting. The general effect of this combination was to give a greater solidity to shape, thereby revealing the contour of the building.

The Round Tower was made a prominent feature by the use of tungsten lamp projectors, variation of luminance stressing its character and rotundity. St. George's Chapel was also illuminated with tungsten filament projector lamps with the East Window illuminated internally as on previous occasions. A few mercury vapour discharge lamps were used in the moat garden, by the Round Tower, for illuminating the trees and shrubs. The electrical loading, previously 140 kw., was increased for this occasion to 250 kw.

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Lighting Abstracts

OPTICS AND PHOTOMETRY

535.24 : 621.327.4

56. Photometric measurements on fluorescent and discharge lamps.

G. PAROLINI, *Elettrotecnica*, **11**, 660-679 (*Dec.*, 1953). *In Italian.*

The author first discusses at length the problems of heterochromatic photometry and describes the various methods used, including the flicker method. He gives a brief treatment of the effect of size of source in the case of fluorescent lamps. The second part of this very long paper describes a series of some 15,000 measurements of luminous intensity and flux made on 19 different types of lamps, using in each case a number of different photometric methods. The values obtained are set out in a series of tables. The work was done in the Institute of Technical Physics at Rome and the equipment of the photometric laboratory there is described. A discussion of the results obtained follows and it is concluded that an accuracy of some ± 5 per cent. is possible, using visual methods of measurement. J. W. T. W.

57. Investigations on the Ulbricht sphere. 535.24

H. KORTE AND M. SCHMIDT, *Lichttechnik*, **6**, 88-91 (*Mar.*, 1954). *In German.*

This communication from the Physikalisch-Technische Bundesanstalt deals with possible sources of error in the measurement of luminous flux in an integrating sphere. When the screen is relatively large (30 cm. diameter in a 2m. sphere), there may be an error of 2 to 2.5 per cent. when comparing a ring filament and a cylindrical filament lamp owing to the different light distributions and the disturbance of reflected light by the screen. The authors suggest various methods of overcoming the difficulty, including the use of a translucent screen. The other matters dealt with are (i) the effect of non-uniformity of reflection factor of the sphere surface, and (ii) the large changes of colour temperature produced by certain paints and the consequent error in comparing two sources giving lights of colour temperatures differing by some hundreds of degrees. Finally the effect of room temperature on the reflection factor of the sphere paint is briefly treated. No references to earlier work are given. J. W T. W.

LAMPS AND FITTINGS 621.327.4

58. American trends in the discharge lamp industry.

E. W. BEGGS, *Lux*, **21**, 104-110 (*Dec.*, 1953). *In French.*

Reviews the present American position with (1) mains voltage tubular fluorescent lamps, and (2) with the recently developed H.P.M.V. lamps with fluogermanate phosphor.

(1) The American colours are indicated, with the present sales tendencies. The 40-watt lamps are the most widely used, but the sales are dropping: the 96-in. T-12 lamp is increasing in popularity. The "Cool White" colour is the most popular and is gaining ground; sales of "white" lamps are diminishing and the remainder are steady. The Deluxe colours have a small sale. The new "Trigger Start" and "Rapid Start" circuits are described. Lamps have been developed for working at low ambient temperatures.

(2) H.P.M.V. lamps have been increasingly used for street lighting; it is claimed that 4,000 miles are now lit with mercury, with an increase of 1,000 miles per year. The new fluorescent H.P.M.V. lamp is described in detail and its applications are quoted. The ratings available in the United States—400-watt, 700-watt and 1,000-watt—have been used for open spaces and large industrial installations. The author predicts an important future for these lamps. J. M. W.

LIGHTING 628.93

59. The eye, sight and lighting.

G. VON BAHR. *Ljuskultur*, **25**, 83-88 (*No.* 4, 1953). *In Swedish.*

The sensitivity of the eye to light is such that a sensation results from the incidence of a very few quanta, but at low levels the eye is shortsighted, has low contrast sensitivity, and low visual acuity. Very high levels of light also cause a tax on the eye, of which snowblindness is an example. Suitable levels of artificial lighting are discussed, together with suitable colour characteristics of lamps for interior lighting, but it is pointed out that the colour of the lamp as looked at is less important than its colour-rendering properties. R. G. H.

60. Lighting for textile production. 628.972

H. HEWITT. *Trans. Illum. Eng. Soc.* (*London*), **19** (*No.* 3, 1954).

Surveys the use of artificial lighting in the textile industry, and refers to lighting problems and installations relating both to natural and artificial fibre working. Particular reference is made to technical and economic factors involved in the use of fluorescent lighting and the equipment available is discussed. Some installations involving novel methods of layout and control are discussed, and reference is made to the latest applications of light sources for inspection and quality control. W. R.

61. Studies in interior lighting. 628.93

J. M. WALDRAM. *Trans. Illum. Eng. Soc.* (*London*), **19** (*No.* 4, 1954).

Records studies on three aspects of interior lighting. Adaptation, Revealing of Form and Texture, and Emphasis. The Mechanism of Interior Lighting is discussed and the conception of Apparent Brightness is introduced as a design factor which accords better with experience than absolute luminance. Apparatus for the qualitative and systematic study of modelling and shadow are described, and methods of classifying modelling and portraying the modelling capability of lighting are proposed. Emphasis is discussed qualitatively, and reference is made to the use of judging panels in its study. The effects of the factors discussed are considered and possible lighting techniques are described. An appendix gives definitions of special terms used in the paper; a second appendix discusses techniques used, and a third describes the new method of calculation. W. R.

628.93

62. A comparison of measured and calculated coefficients of utilisation.

J. R. JONES AND J. J. NEIDHART. *Illum. Engng.*, **49**, 127-133 (*March*, 1954).

Measurements of the coefficients of utilisation of three representative types of fitting (indirect, general diffuse and direct) have been made in two sizes of full-scale test room to determine the accuracy of values calculated by the Harrison-Anderson method and by the Jones-Neidhart Zonal-Factor Interflectance method. In general, the Zonal method was found to give coefficients of utilisation having a greater accuracy than those calculated by the Harrison-Anderson method. P. P.

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Solid Angles Applied to Visual Comfort Problems

By P. PETHERBRIDGE, B.Sc., and J. LONGMORE

A review is made of a number of existing equal-area space projections with which solid angles can be calculated. For the evaluation of discomfort glare problems a semi-sinusoidal (cylindrical) projection is shown to have a number of advantages. A basic diagram and its accompanying droop lines are described, as also is a modification to the droop lines to allow for the reduced glare effect of light sources located off the line of vision. Descriptions are given of the principles of operation of two steradian gauges with which solid angles subtended by lighting fittings can be measured.

One of the factors on which glare discomfort depends is the apparent size of the glare sources or the solid angle which they subtend at the eye. Another factor is the luminance of the background against which the sources are viewed. To determine the mean luminance of a background having a complex luminance pattern it may be necessary to weight individual values with their subtended solid angles.

A need has therefore arisen for simple methods of determining solid angles in order that the results of recent discomfort glare researches can be applied to the solution of visual comfort problems.

Some existing methods of calculating solid angles

The solid angle subtended by an object at a point is defined as the area intercepted on a sphere of unit radius by lines drawn from the point to the bounding edges of the object. This angle can be obtained with sufficient accuracy for many purposes merely by dividing the projected area of the object by the square of its distance from the point.

When the object is very large compared with its viewing distance, of an irregular shape or located obliquely to the line of view, this approximation may not be sufficiently accurate or convenient to apply. Special diagrams on which equal solid angles can be represented by equal areas are of assistance in such cases.

One such diagram already familiar to lighting engineers is Sanson's net, a sinusoidal projection popularly known as an "onion" diagram. Another equal-area diagram is the azimuthal projection devised by Lambert and used by Logan[1] in his work on the field flux method of lighting design.

These two diagrams are found to have a number of disadvantages when applied to the solution of discomfort glare problems. For example, both horizontal and vertical edges in the field of view become distorted. To facilitate plotting straight edges it is therefore necessary to have two sets of curved guiding lines. This double distortion also makes it difficult to incorporate additional data in the diagrams. Another disadvantage is that each of the diagrams covers only 180 degrees horizontally. To plot the entire visual field (which extends to about 100 degrees horizontally on either side of the direction of viewing) two similar diagrams are therefore required whose shapes do not lend themselves to easy combination.

The semi-sinusoidal or cylindrical projection

An alternative form of equal-area space projection having none of the above disadvantages is the semi-sinusoidal or cylindrical projection. This projection gives a rectangular web whose appearance is not unlike the more familiar Cartesian co-ordinate web. In practice it has been found convenient to use a basic diagram representing a quarter-sphere of environment drawn on this projection and to build up the complete hemisphere of environment from it.

The basic diagram, which extends from eye level to the zenith and from the direction of viewing to 90 degrees horizontally on either side, is shown in Fig. 1. The corresponding quarter-sphere of environment below eye level is obtained by inverting the basic diagram. The remainder of the environment is obtained by shifting the basic diagram 90 degrees to right and left when in the upright and inverted positions.

Anyone who has used the Waldram sky factor

The authors are with the D.S.I.R. Building Research Station.

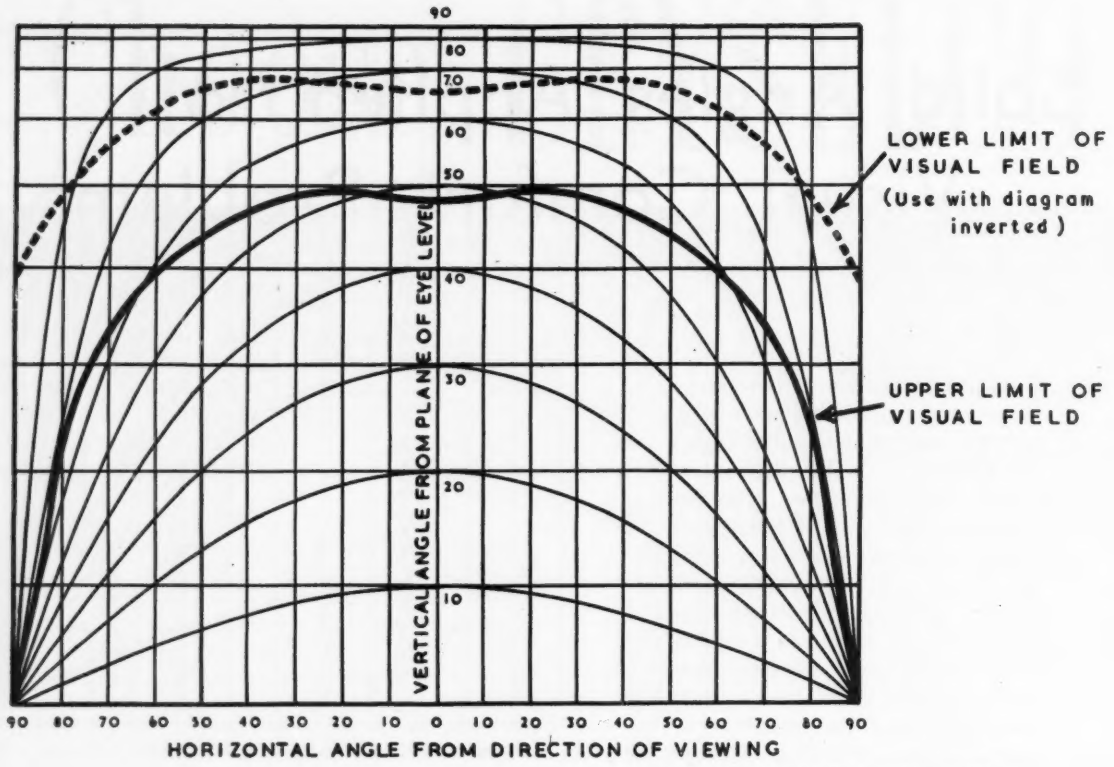

Fig. 1. *Semi-sinusoidal (cylindrical) projection showing droop lines and limits of visual field.*

diagram will be familiar with the basic diagram technique and also the droop lines referred to later.

Vertical edges in the field of view are represented on the projection by vertical straight lines.

Horizontal edges in the field of view are represented on the projection by curved lines. To facilitate plotting such edges a system of curved guiding lines (known as droop lines) has been produced. These lines are shown superimposed on the rectangular web in Fig. 1 and are identified by the angle of the corresponding horizontal edge above (or below) the plane of eye level.

In order to convert areas on the diagram into solid angles, the overall area of the basic diagram has to be related to the solid angle which it represents (π steradians). For example, each square centimetre on the diagram will represent 0.01 steradians if the overall area is made 100 π sq. cm.

For the purpose of visual comfort studies it is an advantage to know the limits of the field of view in relation to the disposition of the light sources and their background. Such limits have been superimposed on the basic diagram of Fig. 1, the upper curve, which defines the lower limit of the visual field, being used with the diagram inverted.

An application of the semi-sinusoidal projection is given in Figs. 2 and 3. Fig. 2 shows the interior of an office in which a visual comfort study was made. Fig. 3 shows the same office plotted on the projection so that the solid angles subtended by the windows and by other interior surfaces could be readily determined.

It will be seen that vertical edges are undistorted and that horizontal edges follow the curvature of the droop lines. In order to include the complete visual field the

Fig. 2. *Office interior.*

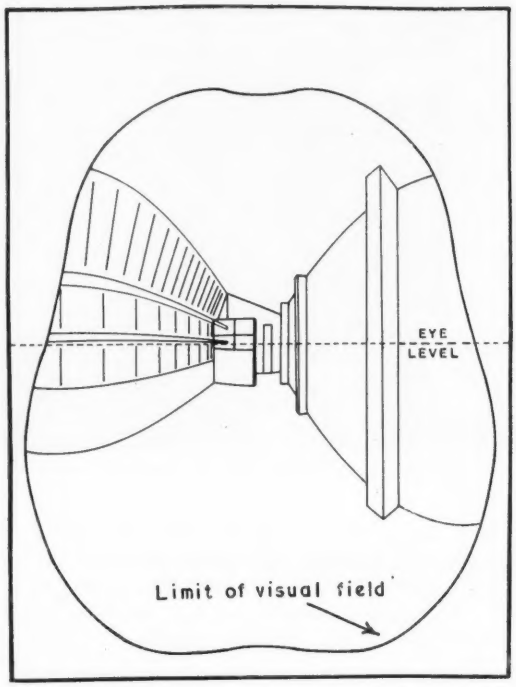

Fig. 3. Office interior plotted on semi-sinusoidal projection.

width of this diagram has been extended from 180 to 215 degrees.

Effect of Position of Glare Source

Advantage has been taken of the fact that the semi-sinusoidal projection is a rectangular web in order to incorporate an allowance for the influence on discomfort of the position of the glare source in the field of view.

It has been found that glare discomfort becomes less as the source is displaced farther from the direction of viewing, and this decrease in glare has been expressed in terms of the equivalent increase in source luminance required to maintain constant glare[2] [3].

An alternative interpretation of the data, which has not been examined experimentally, but which is believed to be reasonably accurate for most practical purposes, is to consider that the decreased glare is equivalent to that of a source in the direction of viewing whose apparent size has been reduced.

Fig. 4 shows the droop lines of Fig. 1 when the apparent sizes of different parts of the visual field have been reduced in accordance with this interpretation. Three sets of droop lines are shown, corresponding to horizontal edges in planes normal and parallel to the direction of viewing.

The office interior of Fig. 2 has been replotted on this modified projection and is shown in Fig. 5. A comparison between this figure and Fig. 3 shows that in the centre of the diagram the details of the office are at least as large as before, whereas at points off the direction of viewing the details have considerably diminished in size, corresponding to their reduced glare effect. In particular the windows occupy a considerably smaller area, indicating that their influence on glare discomfort is much

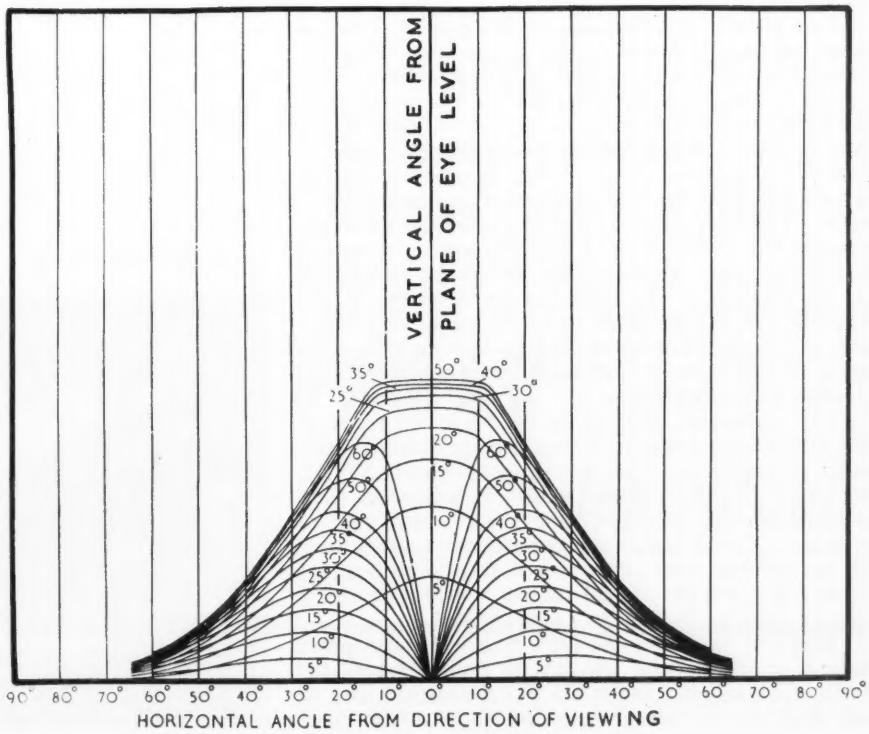

Fig. 4. Droop lines corresponding to semi-sinusoidal projection modified to allow for effect of glare source position.

less than might be expected merely from a consideration of their apparent size.

Instrumental Methods of Measuring Solid Angles

When the need arises to measure solid angles in completed lighting installations, rather than to predict them at the design stage, some form of sighting gauge is required. Two types of steradian gauge which have been developed at the Building Research Station, and which have been constructed from materials readily available in the laboratory, are shown in Fig. 6.

The simplest and most practicable instrument is the "slide rule" type of gauge. This consists of a clear plastic viewing screen mounted at right angles to one end of the slide of a simple slide rule. The screen has engraved on it a grid of concentric shapes. There are four pairs of these shapes—circles and squares—each corresponding pair being of equal area. The solid angles which these areas subtend from the other end of the instrument are accurately known. The instrument is used by holding this end to the eye and viewing the plastic screen along the slide. The viewing distance, and hence the solid angles subtended by the shapes, can be varied by moving the slide relative to the stock. The stock has engraved on it four inverse-square scales graduated in solid angles, each scale corresponding to one of the pairs of shapes on the screen. A cursor attached to the slide passes over these scales and enables the solid angle subtended by each square or circle at the user's eye to be read off directly. Thus, if the instrument is sighted towards a light fitting from the position at which it is required to measure its apparent size, and the slide is adjusted until one of the squares or circles on the screen fits as nearly as possible the bounding edges of the fitting (see Fig. 7), the solid angle subtended by the fitting is given by the reading on the appropriate scale.

Two possible disadvantages of this type of steradian gauge are the limitation on the maximum solid angle measurable with the instrument (0.0275 steradians in the laboratory version) and the fact that the eye has to focus alternately on the light source and on the screen. These disadvantages are overcome in the "telescopic" type of steradian gauge also shown in Fig. 6, which is derived in principle from the familiar direct-vision camera viewfinder. This instrument consists of a tube with a concave reducing lens at one end and a small aperture or viewing lens at the other. Mounted close behind the field lens is an iris diaphragm. By adjusting the aperture of the diaphragm it can be made to fit as nearly as possible around the reduced image of the light source and the solid angle subtended can then be read from a calibrated scale attached to the diaphragm.

This instrument obviates the need for dual focusing. The laboratory version has a similar range of solid angles to the slide-rule type of gauge, i.e., approximately 200 : 1, but measures a much greater maximum solid angle (1.35 steradians). The minimum solid angle which can be measured (0.0062 steradians) corresponds roughly to a 12 in. diameter opal globe viewed from a distance of 11 ft. 3 in. For very small sources a field lens with a smaller reducing factor can be substituted.

Steradian gauges of the type described may prove difficult to use in some daylighting studies where the surfaces whose solid angles are to be measured may be too large to be viewed conveniently or where these

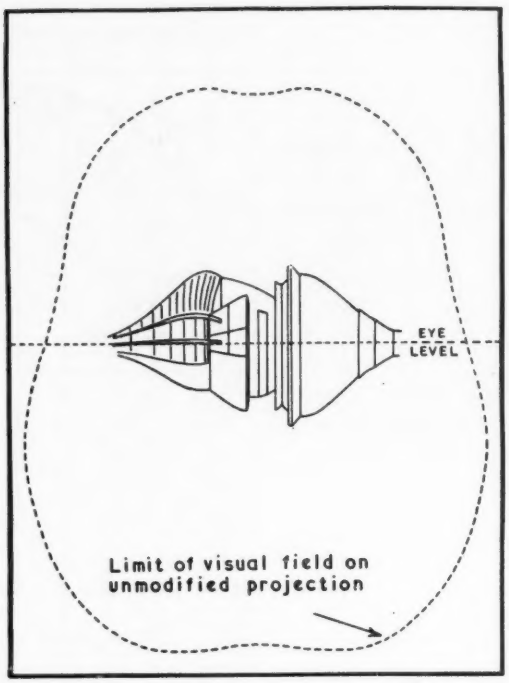

Fig. 5. Office interior plotted on modified semi-sinusoidal projection.

Fig. 6. Steradian gauges.

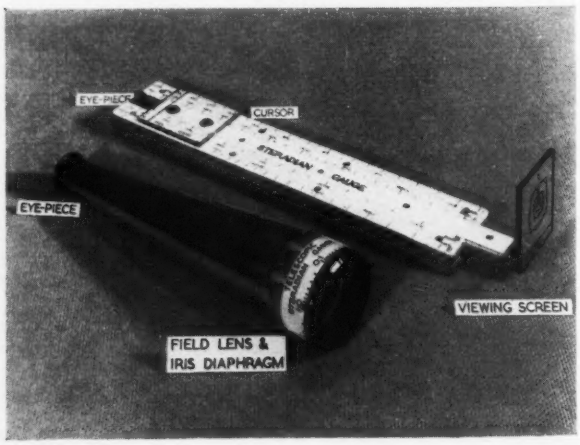

Fig. 7. Slide-rule type of steradian gauge in use

surfaces may be seen obliquely and hence have an apparent shape that is markedly different from the fields in the gauges. In such cases the diagram method described earlier should be used, the angular dimensions of the room interior being obtained either *in situ* or from working drawings.

Conclusions

The semi-sinusoidal or cylindrical projection has been shown to have a number of advantages over other existing equal-area space projections for the calculation of solid angles required in connection with glare studies. The projection lends itself readily to the construction of droop lines and to the incorporation of an allowance for the reduced glare effect of light sources located off the direction of viewing.

In order to measure solid angles in completed lighting installations, steradian gauges of simple design can be constructed from readily available materials.

Acknowledgments

The work described has been carried out as part of the research programme of the Building Research Board of the Department of Scientific and Industrial Research, and this paper is published by permission of the Director of Building Research.

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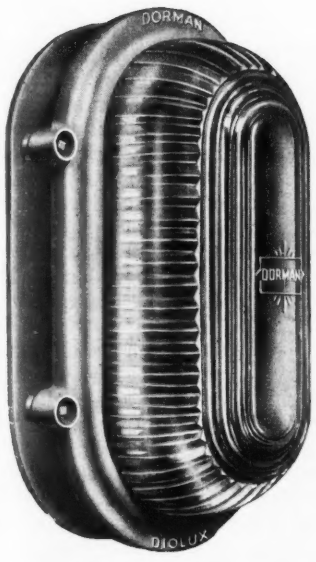
DORMAN PRISMATIC LIGHTING FITTINGS



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Cold Cathode Street Lighting

Fig. 1. Cold cathode fluorescent lanterns in Union Street, Aberdeen, including four mounted on columns.

Aberdeen now has as its latest feature of civic development a modern street-lighting system which is the only one of its kind in the world. The first section of the new system was officially switched on at the beginning of April.

For nearly 200 years Aberdonians have striven to enrich local amenities, developing a small but prosperous port into a handsome city. To-day Aberdeen's most striking features are the lay-out of its main streets and the design of its buildings. Two most important streets, Union Street and Union Terrace, are now being equipped with cold cathode fluorescent lanterns.

When the relighting was planned, the Superintendent of Lighting, Mr. Ronald Parker, and the Director of Town Planning, Mr. James E. Barlow, worked closely together on the local problems.

Union Street, broad and carrying heavy vehicular and pedestrian traffic, is bordered by dignified granite buildings. All radial roads converge on Union Street, which is the main road. In 1950 a scheme was considered for this area, using G.E.C. "Four Eighty" vertical fluorescent lanterns, and a number were installed experimentally. The new G.E.C. cold cathode lantern was introduced soon after. Since it was felt preferable to light Union Street without using columns and so keep the broad, clear aspect of the street, this lantern, which was adaptable for wall mounting and harmonised with the surroundings, seemed ideal. It was, therefore, incorporated in the scheme and the "Four Eighty" lanterns used elsewhere. This solved the column problem but created one of maintenance. Routine maintenance of lanterns with tower wagons might obstruct pavements and shop fronts.

This problem was overcome by using cold cathode fluorescent tube which has a very long life of 15,000 hours. It is unlikely that the lanterns will have to be opened for about four years. When attention is needed, each lantern can be removed from the wall and quickly replaced.

Each lantern has five 67½-watt tubes with a total light output about equalling that of a normal main road lantern with a 400-watt mercury lamp. The tubes are inside an opal "Perspex" cylinder with decorative aluminium fittings, which house the transformers and control gear.

Erection of the lanterns is being carried out by the Council's streetlighting department. Mounting plates for the lantern brackets are each fixed to the buildings by three "Rollofix" wall anchors. Nearly 1,000 holes for these had to be tapped in granite with pneumatic hammers using tungsten-tipped tools. The electricity supply is taken from rising mains at the foot of the buildings. Firemen's switches to isolate sections are fixed at intervals. Wiring along the buildings' faces is in aluminium sheathed rubber covered cable. Aluminium

sheathing tones well with the granite. Time switch control is being used until a central control system is approved.

Since Union Street varies in gradient, and building façades differ in architectural features, spacing and mounting heights could not be rigidly fixed. These have been varied in some cases to suit the buildings and to give the best overall impression of the lighting system.

The wall brackets have been specially designed to allow the lanterns to be removed without disturbing the wall fittings. They also allow adjustment to be made in projection from the building faces. Where the building heights and building line have varied markedly, special brackets are used to keep the lantern arrangement symmetrical. Some special brackets are on the corners of buildings, others like flagpole mountings give extra height where needed.

Reflected light from the buildings is a valuable factor where a wide street is lighted by wall-mounted lanterns. A statutory power of the Aberdeen Council will help to maintain this factor since property owners in Union Street can be compelled to clean building exteriors when this is considered necessary.

At Union Bridge, wall-mounting was not possible and columns are used. Due to the structural characteristics of the bridge, special light-weight aluminium columns had to be designed to carry the lanterns at this point. These have been made, however, to withstand the stresses caused by gales of up to 100 m.p.h. Some post-mounted lanterns are also used to ensure adequate lighting in the broad Castle Street.

When the system is complete 170 of this latest type cold cathode fluorescent lantern will be in use.

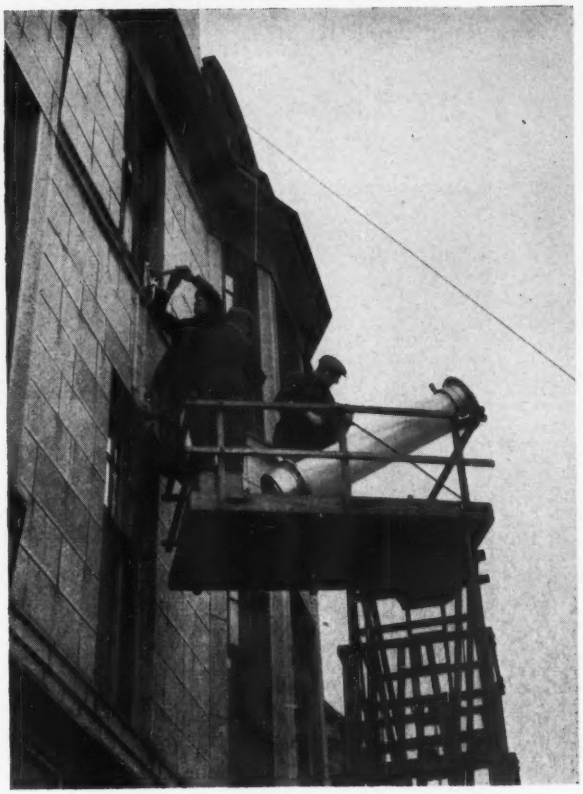
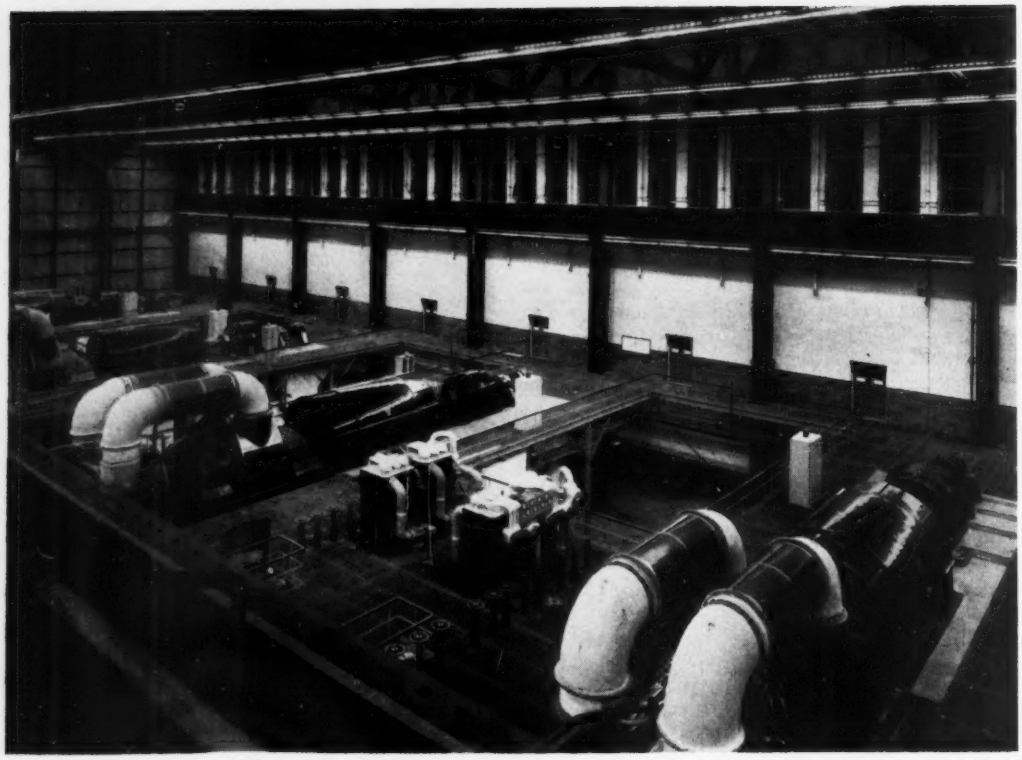


Fig. 2. *Erecting lanterns in Union Street*

Fig. 3. *Wall-mounted lanterns in Union Street.*

Lighting Installation

A Power Station

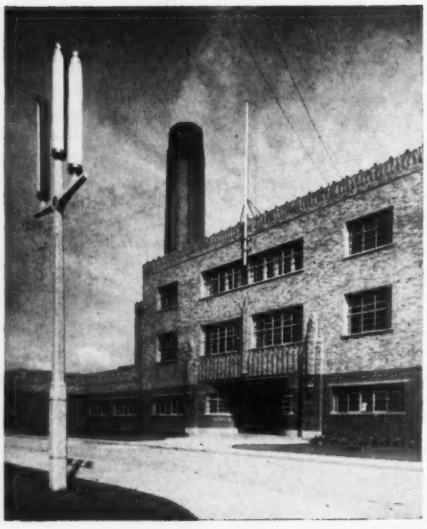


Fluorescent lighting has been used almost exclusively in the boiler house, turbine hall and offices of the new Rye House Power Station.

The turbine hall, at present 280 ft. long by 115 ft. between crane rails, accommodates four 30 mw 33 kv turbo-alternators each with a 2 mw 3.3 kv auxiliary alternator on the same shaft. Ultimately a further two alternators may be installed bringing the turbine hall up to 420 ft. long. Lighting is from four rows of reflectors mounted on 4-in. x 4-in. cable trunking suspended by chains from the roof girders, supplemented by parabolic reflectors beneath the crane rails and across the end wall over the unloading bay.

Over seven hundred 5-ft. 80-watt White (3,500 deg. K) lamps are used in the turbine hall giving slightly above 20 lm./ft.^{2} on the turbine floor and 18 lm./ft.^{2} in the basement.

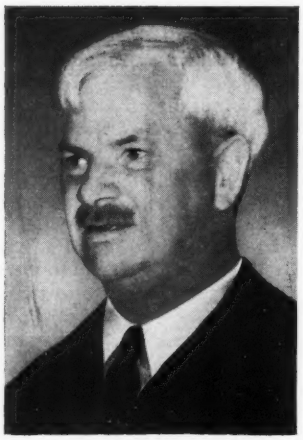
Another interesting lighting feature at Rye House is the special lanterns, each with two 5-ft. 80-watt White (3,500 deg. K) lamps, in bronze finish on concrete standards which flank the approach road. Similar lanterns, mounted in tricent formation, overlook the ornamental fountain on the green in front of the main entrance.



Designed by: B.E.A. (Eastern Division) and Thorn Electrical Industries Ltd.

Installation by: Eastern Electricity Board.

Obituary



R. O. ACKERLEY

It is with deep regret that we have to record the sudden death on Thursday, April 22, at the age of 59, of Mr. R. O. Ackerley, M.C., M.I.E.E., F.I.E.S., by which the Illuminating Engineering Society and the lighting industry have lost one of their best known and most loved members.

A King's Scholar at Eton, Mr. Ackerley served throughout the Great War of 1914-18 with the South Wales Borderers and was awarded the M.C. On his demobilisation he joined the General Electric Co. Ltd., and served in the sales organisation of that company, first in London and afterwards for five years with the British General Electric Pty. Ltd. of South Africa. He returned to England in 1929 and two years later took charge of the Company's Illuminating Engineering Dept., which position he retained until his retirement in 1949.

He joined the I.E.S. in December, 1931, a time when there was little science in applied lighting, and a great deal of his influence was in encouraging an engineering approach, insisting on an analysis of the problem as the first step towards a statement of lighting requirements. He developed this theme in many ways, but in particular his discussions of " task analysis " will be remembered. He was particularly concerned with the unusual aspects of lighting and the introduction of hot cathode discharge lamps, which became available in 1933, encouraged him to try these revolutionary sources for industrial lighting and for floodlighting. He achieved considerable success in both applications, and the team of engineers which he led did some particularly interesting decorative lighting for the Silver Jubilee celebrations of 1935. It was this wide experience of problems in the application of light as seen by his analytical mind which moved him to write " An Introduction to the Science of Artificial Lighting." " .... to give an insight into the essentials sufficient to enable . . . an architect or engineer . . . to guide a client on broad lines. . . . " This book was far from being the only effort which he made to bring architects and engineers under the same umbrella. He encouraged joint meetings of the Illuminating Engineering Society and the Royal Institute of British Architects, and took a prominent part in formulating the Dow Memorial Prize which has similar aims.

These endeavours were made more easy for Ackerley because of his skill at exposition. He had a great ability to project his charm and enthusiasm across to an audience, and he always " went down well " whether with adults or children. With him I had the fun of giving the first series of I.E.S. children's lectures at Bradford at Christmas, 1943. Time for preparations was much restricted in those war years and we finished setting up our demonstration equipment and arranging the lantern slides in the small hours of the night before the lecture. After a brief use of our beds we arose to have a fair copy typed of our lecture notes, and this was finished as the children crowded in. R.O.A. then talked and I demonstrated, the two going hand in hand rather by telepathy than by pre-arrangement. It should not be thought, however, that R.O.A. lectured without rehearsal: his casual style invariably concealed careful preparation.

Few men have worked harder for the Illuminating Engineering Society. He was president for the session 1942-43, and chairman of the 1946 Convention Committee and of the 1948 Summer Meeting Committee. In 1941 he gave an address on " Lighting and Reconstruction " as a result of which a committee of the Society was set up under his chairmanship. This committee and its sub-committees prepared a series of lighting reconstruction pamphlets which had wide circulation in the post-war years. R.O.A. continued in this office until the committee was dissolved in 1946, and soon after he became chairman of the newly formed Development Committee. He continued to take an active part in the Society's affairs, even though other interests called him also. He was an energetic chairman of the Utilisation Section of the Institution of Electrical Engineers.

He had an unfailing sense of fun and will be remembered happily as organiser of light-hearted evenings: life to him was to be taken as it came, and enjoyed. The Society owes much to him and is deeply grateful for his service.

A memorial service to R.O.A., as he was so fondly known, was held at the Queen's Chapel of the Savoy on Thursday, April 29, when many representatives of the lighting industry were present. W. R. S.

Personal

Thorn Electrical Industries Ltd. announce the appointment of MR. ERIC HUTCHISON to the " Atlas " Lighting Division, as a special representative for the Scottish area. He was previously with the Illuminating Engineering Department of the General Electric Company, Ltd.

MR. J. O. WILSON has joined The Edison Swan Electric Co. Ltd., as representative to Southampton District Office. He was formerly representative attached to the Domestic Appliance Division of The English Electric Co. Ltd. He also spent 14 years with Kennedys (Bournemouth) Ltd., Electrical Wholesalers, attaining the position of Assistant Manager, Southampton Branch.

On Friday, April 9, The Edison Swan Electric Co. Ltd., officially said good-bye to Mr. V. A. Bagnall, on his retirement from the position of representative in the Birmingham District Office area. He had been with Ediswan since November, 1929, and had been very popular with all the customers in his territory as was proved by the numerous letters of appreciation which he received from buyers and engineers of many companies on his retirement. The presentation of a Desk Set was made to him by MR. A. H. ADEY, Manager, of Ediswan Birmingham District Office on behalf of the staff.

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Trade Notes

On May 1 THORN ELECTRICAL INDUSTRIES, LTD., added to their home range of fluorescent lamps a new colour known as "Atlas De Luxe Warm White" which is available in all the usual lengths and wattage ratings. In colour appearance the new tube approximates to the colour of tungsten filament lighting whilst the colour rendering provided by the two sources is also very similar. The 80-watt tube has an efficiency through life of 33 lumens per watt, whilst the corresponding figure for the 40-watt tube is 36 lumens per watt.

EKCO-ENSIGN ELECTRICAL, LTD., have also added a new colour known as the "Ekco De Luxe Warm White" to their range of fluorescent lamps with properties similar to those described above.

J. STONE & COMPANY (LTD.), electrical and mechanical engineers and founders, of Deptford and Charlton, have bought the engineering interests of CHANCE BROTHERS, LTD., of Smethwick. These interests include the manufacture of Sumo electrical submersible pumps, marine lighting and lighthouse equipment and fog signalling apparatus, and Austinlite automatically controlled electric generating plant, switches and instruments. CHANCE BROTHERS, LTD., will continue to manufacture the glass products for which the firm is renowned with Dr. W. M. Hampton, formerly technical director, as managing director and Mr. C. J. S. Newman as deputy.

The Manchester firm EDWARD WILCOX & CO., LTD., manufacturers of the "Slydlox" range of fusegear, announce the opening of their new London Office at Fulwood House, Fulwood Place, Holborn, London, W.1. (Telephone CHAncery 2206.)

GEORGE BURN LTD., of Smethwick announce the introduction of a new range of tube, combining the qualities of plastics with the rigidity of steel. The new product, marketed under the name of "Burcol" tubing consists of normal steel tube covered with a skin of P.V.C. (Poly-vinyl Chloride) material.

OLDHAM & SON LTD., Denton, Manchester have received official approval for a cap lamp certified safe for use in hydrogen. This is the first time a certificate has been issued for any cap lamp for use in hydrogen and the first certificate issued for any electric lamp to be used in hydrogen since the regulations were recently revised.

Trade Literature

METROPOLITAN-VICKERS ELECTRICAL CO., LTD.—Form 9362 dealing with eight-foot fluorescent lamps and fittings for uses including factory, garage, textile mill and power station lighting. Fully illustrated with details of lamps, their fittings and auxiliary gear, in each case.

FALK, STADELMANN & CO., LTD.—Catalogue No. 802/54 giving full details and prices of all electrical accessories and control units manufactured. Well illustrated, this list is presented in loose-leaf form so that pages may be added as new lines become available.

ANGLO-AMERICAN ELECTRICAL CO.—Catalogue illustrating a selection of the popular "Daybriter" fluorescent luminaires giving full details and prices with each illustration.

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Lighting Installation

A Transformer Factory

A modern factory of the type used for the manufacture of large transformers calls for special treatment in its lighting requirements. Before deciding on the type of lighting to be used at the new transformer factory of Ferranti, Ltd., at Hollinwood tests and trials with different light sources were carried out to study their economics, colour rendering, etc.

In building large transformers a high value of vertical illumination is necessary and it is important to be able to see easily into the many recesses in the structures. Colour discrimination is essential with the many and varied materials used. To clear the overhead travelling cranes, high mounting heights of 64 ft. in the high bays and 40 ft. in the low bays have to be taken into account.

It was obvious with the factory occupying a floor space of some four and a half acres that a large number of lighting units would be required and that by keeping the number to a minimum maintenance costs would be proportionately less. Against this, however, was the fact that the smaller the number of units, the worse the shadows from the huge travelling cranes; two or more of which might often be working in close proximity.

Three possible schemes were investigated :—

(1) A blended light scheme using 400-watt mercury discharge lamps and 1,000-watt tungsten filament lamps.

(2) A cold cathode scheme using three-tube 9 ft. 6 in. (75 watts each approximately) units.

(3) A hot cathode scheme using twin-lamp 8-ft. 125-watt units.

The first scheme had two major disadvantages from which the other two schemes did not suffer—the high electrical loading it involved, and the heavy shadows created by the cranes.

The other two schemes showed a number of advantages common to both, but a decision in favour of using hot cathode lamps was taken for the following reasons : Servicing of the installation would have to be carried out from the top of the cranes which, in the larger bays, are 64 ft. above floor level, and it was found that maintenance and replacement of lamps could be carried out easily by one man working from the top of the crane. In addition, considerable vibration is set up by the cranes (five of which are operating almost continuously in the larger bays) and it was found that the robust 8-ft. lamp stood up very well to this.

The installation, the work on which has been spread over three years, was designed to give an average illumination of 15 lm./ft.^{2}; some 1,800 lamps are used mounted in heavy gauge metal through reflectors which are slotted to give some upward light. Each unit has a separate three-pin plug and socket to enable the maintenance staff to remove or replace any luminaire quickly.

Designed by : Metropolitan-Vickers Electrical Co., Ltd., in co-operation with Mr. E. Morris, Works Power Engineer, of Ferranti, Ltd.

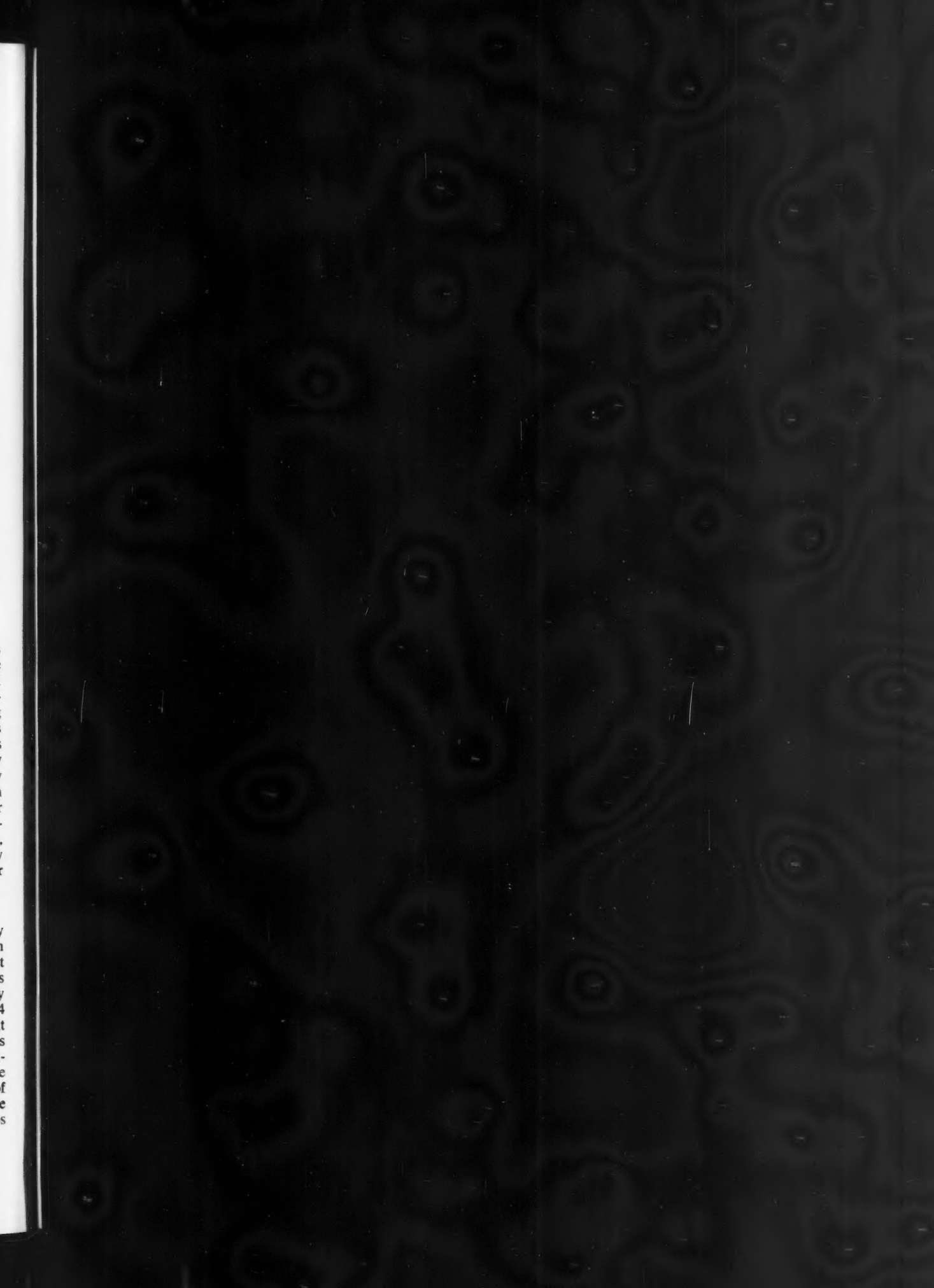
POSTSCRIPT By "Lumeritas"

This is the month when Nature is most magnificent to us here in respect of light, and gives us least cause to be interested in artificial lighting. Although the calendar designates the twenty-first of the month as the "longest day," the twenty-second appears to have an equal claim to this distinction, for—at any rate to the nearest minute—the period between sunrise and sunset is just as long on both of these days. No doubt there is a difference of a few seconds, about which most of us "couldn't care less." But June as a whole is, normally, the most "daylightful" of the months, and we can expect that—"on the average"—its days will give us, in unshaded positions outdoors, an illumination of not less than 1,000 lm./ft.^{2} for not less than 11 hours. We can also expect that for between 14 and 15 hours on June days the outdoor illumination will not fall below 300 lm./ft.^{2}. Not only is June's hemeralucency welcome to those who work in buildings where adequate daylighting is only experienced in the summer months—if at all, but how we all love it and are cheered by it!

The length of the day is a matter of "interest" to plants as well as to ourselves, as appears from one of the papers presented at the recent Southport meeting of the I.E.S. In this paper (Artificial Lighting for Plant Growth), Mr. A. E. Canham explained that the relative daily duration of light and darkness is the controlling factor in the development of many plants to the flowering stage. It has been found, he said, that plants can be classified in these groups, namely: long-day plants, which flower only when the length of day exceeds a certain value; short-day plants, which flower only when the length of day is less than a critical value; and plants which do not appear to be particular about the length of day. This phenomenon of photoperiodism is, of course, only one of the interesting topics dealt with in Mr. Canham's paper.

Such aids to lighting designers as tables of interflectance factors give no hint to their users of the labour involved in preparing them, and I imagine that, like myself, many others who see these tables do not realise by what formidable equations the calculated factors are obtained. In the April issue of the journal of the American Illuminating Engineering Society one of these equations is printed—it is no less than 18 in. long! It has been used—together with two other equations whose length I know not—for compiling new interflectance tables, and if the authors of these had no electronic brain at their disposal I take off my hat to them for their industry! It was reported that on Budget Day in April some of our own figure-mongers were standing-by borrowed electronic brains waiting to set them calculating new and more favourable tax tables at a word from the Chancellor of the Exchequer! Alas, the word was never given, the electrons never unleashed!

Liverpool's Medical Officer of Health, Professor Andrew B. Semple, has recently drawn attention, in his annual report, to the need for implementation of the Gowers Committee's recommendations as to conditions in offices and workplaces not covered by other provisions. "The absence," he writes, "of powers of enforcement in this direction was particularly noticeable in the case of certain workplaces, such as laundries, cleaning and dyers' receiving depots. The workers in these classes of premises, which are neither shops nor factories, do not enjoy the amenities or welfare arrangements contained in the Shops Act and the Factories Act. . . . Lighting in workplaces and particularly in offices does not appear to receive the degree of attention merited by its importance, although there is a general desire for better lighting, both natural and artificial, by workers. There should be adequate and satisfactory lighting for all purposes. This improves output, comfortable working conditions, and most important, exposes dirty environmental surroundings. As these benefits of good lighting are usually accepted by most persons, it is all the more surprising to find clerical workers not infrequently carrying out their work in a luminous intensity as low as 2 or 3ft.c., which is very poor compared with 15 to 20 ft.c. recommended by the Lighting Committee of the Building Research Board and other authoritative bodies for this type of employment. It has, therefore, been the practice to advise the occupiers of commercial buildings where the standard of illumination was inadequate, and this action has had very satisfactory results." Other M.O.H. please note, and act similarly.

The variety of "housings" for fluorescent lamps grows apace, and in the advertisement pages of one recent issue of this journal and of "Illuminating Engineering" I counted no less than 40 different fluorescent fittings, fixtures, luminaires or what you will, most of them being "new models." So far as appearance goes, there does not seem to me to be much to choose between the products of different manufacturers. However, there are so many tastes to please that doubtless there is room for many "stylings." Then, of course, there are differences in materials, finishes, methods of fabrication, design for fixing, re-lamping and cleaning, light distribution, luminous efficiency and so on—as well as in price. Fortunately, "contemporary" designs equal in craziness to some now marketed for tungsten lamps have not yet made their appearance—at least I have seen none.

The growing practice of lighting shop windows by "louverall" ceilings, or by extensive luminous panels in the ceiling of the window space, is not so novel as might be supposed. In the June issue of this journal 46 years ago (Vol. 1, p. 453) appeared a photograph of a drapery store window having a luminous ceiling comprising 24 ground glass panels, above which were mounted eight Welsbach gas lighting units complete with silvered glass reflectors. "As a result a pleasing and uniform illumination is produced, the light being thrown down upon the goods without the possibility of very bright sources of light bewildering the eye of anyone looking in at the window." When will the occupiers of jewellers' shops take note of the latter part of this quotation?